

## LITERATURE CITED

- Mech, D. L. and L. Boitani. 2003. Wolves: behavior, ecology, and conservation. The University of Chicago Press, Illinois, USA.
- Mitchell, M. S., D. A. Ausband, C. A. Sime, E. E. Bangs, J. A. Gude, M. D. Jimenez, C. M. Mack, T. J. Meier, M. S. Nadeau, and D. W. Smith. 2008. In press. Estimation of self-sustaining packs for wolves in the Rocky Mountains. *Journal of Wildlife Management* (used with permission)
- U.S. Fish and Wildlife Service. 1987. Northern Rocky Mountain Wolf Recovery Plan. U.S. Fish and Wildlife Service, Denver, Colorado, USA.
- U.S. Fish and Wildlife Service. 1994. Final Environmental Impact Statement, The reintroduction of gray wolves to Yellowstone National Park and Central Idaho. U.S. Fish and Wildlife Service, Helena, Montana, USA.
- U.S. Fish and Wildlife Service, Nez Perce Tribe, National Park Service, and USDA Wildlife Services. 2003. Rocky Mountain Wolf Recovery 2002 Annual Report. T. Meier, ed. USFWS, Ecological Services, 100 N Park, Suite 320, Helena, Montana, USA.
- U.S. Fish and Wildlife Service, Nez Perce Tribe, National Park Service, Montana Fish Wildlife and Parks, Idaho Fish and Game, and USDA Wildlife Services. 2007. Rocky Mountain Wolf Recovery 2005 Annual Report. USFWS, Ecological Services, 585 Shephard Way, Helena, Montana, USA.

## **APPENDIX A: POPULATION ESTIMATION TECHNIQUE USED TO DETERMINE WOLF POPULATION NUMBERS IN IDAHO**

From 1996 until 2005, wolf populations were counted using a total count technique that was quite accurate when wolf numbers were low and most had radiocollars. We have, for the past two years, used an estimation technique that is more applicable to a fully recovered population and types of data we are able to collect. In 2006 we began using an estimation technique that had been peer reviewed by University and NRM wolf managers. This technique bypasses the need to count pups in every pack, and instead relies on our documented packs, estimated pack size, number of wolves documented in small groups not considered packs, and a percentage of the population believed to be lone wolves. Mathematically this technique is represented as:

$$\text{Minimum Wolf Population Estimate} = ((\text{Documented packs} * \text{mean pack size}) + (\text{Wolves in other documented wolf groups})) * (\text{lone wolf factor})$$

Using this technique, the 2007 wolf population estimate is 732 wolves and represents an increase of 9% over 2006's estimated wolf population:

$$\begin{aligned} & ((83 * 7.7) + (12)) * 1.125 \\ & (639 + 12) * 1.125 \\ & 651 * 1.125 = \\ & 732 \end{aligned}$$

The number of documented packs that were extant at the end of 2007 was 83.

Mean pack size (7.7) was calculated using only those packs ( $n = 34$ ) for which biologists believed complete pack counts were obtained in 2007.

To account for wolves not classified as lone wolves and not associated with documented packs, we included a "total count" for those radiocollared wolves in groups of 2-3 wolves that were not considered packs under Idaho's definition. This resulted in the addition of 12 wolves from 8 groups.

A lone wolf factor (12.5%) was added to account for that component of the wolf population comprised of wolves not associated with packs or groups of 2-3 wolves. This was a mid value derived from 5 peer-reviewed, published studies and 4 non-reviewed papers from studies that occurred in North America and were summarized and reported in 2003 (Mech and Boitani 2003, page 170). For 2007, an estimated 81 lone wolves were in the Idaho population.

It is important to recognize this estimate is not corrected for survey effort and represents only the minimum number of wolves estimated to be present in Idaho. The actual number of wolves in Idaho is likely more than the 'estimated minimum number', as we did not include suspected packs (packs for which we did not have verified evidence) in the estimator. Also, changes in the estimate from year to year are not adjusted to differing amounts of effort put forth to document wolf activity. However, we are comfortable that this estimate is a good representation of packs that have been reported by the public and agency professionals and verified by wolf specialists, and thus a defensible estimate of the minimum population.

## **APPENDIX B. ESTIMATING BREEDING PAIRS BY USING PACK SIZE**

The USFWS established a population recovery goal for wolves in the northern Rocky Mountains to maintain 30 “breeding pairs” of wolves for 3 consecutive years well distributed across the 3 states of Idaho, Wyoming, and Montana. A breeding pair is strictly defined by the USFWS as 2 adult wolves that have produced at least 2 pups that survived through December 31 of their birth year. Breeding pair status is determined at the end of each year and essentially represents a successful reproductive wolf pack. Not all wolf packs reproduce successfully each year or have pups that survive until the end of the year, so not all packs qualify as breeding pairs. Also, not all packs can be observed by project personnel to verify reproductive status. The reason for using this technique for the recovery goal is to provide a measure and estimator of the reproductive success and recruitment of wolves into the population the following year.

As part of the forthcoming Delisting Rule, the USFWS has established a post-delisting monitoring plan that is also based on monitoring breeding pairs. The post-delisting monitoring plan requires the 3 Northern Rocky Mountain (NRM) states to maintain a federally required minimum of  $\geq 30$  breeding pairs and  $\geq 300$  wolves well distributed among the 3 states, including  $\geq 10$  breeding pairs and  $\geq 100$  wolves within each state. During the first 5 years after delisting, federal law will require the 3 states to continue to monitor and report breeding pair status of wolves to insure wolf population levels do not fall below the federally required minimums.

The breeding pair definition places a significant burden on managers because it requires intensive monitoring and a high degree of certainty in assigning breeding pair status. For the past 10 years, during wolf recovery efforts within the NRM states, breeding pair status was determined using intensive and expensive monitoring methods relying on the use of radiotelemetry techniques. Wolves were captured, radiocollared, and tracked through the year from the air and ground. Intensive radiotracking efforts during spring and summer allowed field biologists to locate denning wolves, establish reproductive status of wolf packs, and determine litter sizes. Additional field efforts, including ground and aerial tracking and observations, were required through the fall and winter to determine pup and adult survival and breeding pair status by the end of the year.

This method of determining breeding pair status has become increasingly difficult through time as wolf populations grow and funding and personnel levels remain the same. Federal funding following delisting is in question, adding to this growing concern. In response to these concerns, NRM wolf managers, working through the University of Montana Cooperative Wildlife Research Unit, have developed a new and more efficient method for determining and monitoring breeding pair status of wolf populations. This new method will be used by all 3 NRM states and was evaluated, peer reviewed and approved by the USFWS to be used once wolves are delisted.

Recent development of a surrogate method for determining breeding pair status based on pack size may reduce the level of monitoring intensity required to verify minimum breeding pair status (M. S. Mitchell, U.S. Geological Survey, 2008). In essence, a historical record now exists that provides a correlation between pack size and the probability of that pack meeting the definition of a breeding pair. As pack size increases, the probability that the pack meets breeding pair status increases. For example, the probability that a pack consisting of 10 wolves constitutes a breeding pair is 0.95. Therefore, the model will allow managers to develop probabilistic estimates of breeding pairs on a statewide basis. Because pack size is more easily obtained than

actual pup survival data, monitoring levels needed to ensure minimum breeding pair goals may be reduced.

For Idaho wolves, the correlation between pack size and breeding pair status is presented in Table 1. By definition, there must be a minimum of 4 wolves within a pack to qualify as a breeding pair. In Idaho, even small pack sizes  $\geq 4$  have fairly high probabilities of meeting the breeding pair definition as most packs in Idaho reproduce and recruit offspring into the population successfully.

Table 1. Probability by pack size of a wolf pack containing a successful breeding pair (1 adult male, 1 adult female, and  $\geq 2$  pups), Idaho, 1996-2005 (adapted from Mitchell et al. 2008).

	Pack size										
	4	5	6	7	8	9	10	11	12	13	$\geq 14$
Breeding pair probability	0.65	0.73	0.79	0.85	0.89	0.92	0.95	0.96	0.97	0.98	0.99

Application of this method is simple and straight forward. Once the number of documented packs and their pack sizes are determined for the year, each pack is assigned the probability that it will meet the definition of a breeding pair based on its pack size. Then all probabilities are summed for all packs to produce an estimate of the number of breeding pairs represented by those documented packs. This technique can be applied without any prior knowledge of breeding pair status as illustrated in Table 2. Most often, however, through regular monitoring activities and field work by wolf managers, breeding pair status for some packs may be known, while those of others may not. In this more typical case, those packs that are known to be breeding pairs are assigned a probability of 1.00, or 100%; those packs known not to be breeding pairs are assigned a probability of 0.00, or 0%; and those packs of unknown status are assigned the logistic regression model probabilities based on pack size as listed in Table 1. The procedure is then the same; all probabilities are summed for all packs to obtain an estimate of the number of breeding pairs (Table 3). The IDFG, NPT, and other NRM managers intend to use this new logistic model method post-delisting. The USFWS authorities have approved the technique.

One other advantage of this new technique is that confidence intervals can be developed to provide a measure of precision for this estimate. The logistic regression model was developed during the recovery phase when wolves were protected under the ESA. The correlation between pack size and breeding pair status should be reexamined post-delisting, as this relationship will likely change once wolves are delisted and are subject to regulated harvest.

Table 2. A hypothetical illustration of the logistic regression model of Mitchell et al. 2008 for estimating the number of breeding pairs, given unknown status of breeding pairs, for wolves in Idaho.

Pack	Pack Size	Known BP <sup>a</sup> Status	BP Probability
A	4	Unknown	0.65
B	4	Unknown	0.65
C	4	Unknown	0.65
D	6	Unknown	0.79
E	6	Unknown	0.79
F	6	Unknown	0.79
G	8	Unknown	0.89
H	8	Unknown	0.89
I	8	Unknown	0.89
J	10	Unknown	0.95
K	11	Unknown	0.96
L	11	Unknown	0.96
M	12	Unknown	0.97
N	13	Unknown	0.98
O	15	Unknown	0.99
Estimated number of breeding pairs			13

<sup>a</sup> BP = Breeding Pair(s)

Table 3. A hypothetical illustration of the logistic regression model of Mitchell et al. 2008 for estimating the number of breeding pairs, given both known and unknown status of breeding pairs, for wolves in Idaho.

Pack	Pack Size	Known BP <sup>a</sup> Status	BP Probability
A	4	Yes	1.00
B	4	No	0.00
C	4	Unknown	0.65
D	6	Yes	1.00
E	6	Yes	1.00
F	6	Unknown	0.79
G	8	Yes	1.00
H	8	Unknown	0.89
I	8	Unknown	0.89
J	10	Unknown	0.95
K	11	Yes	1.00
L	11	Yes	1.00
M	12	Unknown	0.97
N	13	Unknown	0.98
O	15	Yes	1.00
Estimated number of breeding pairs			13

<sup>a</sup> BP = Breeding Pair(s)

Technique derived from and published in:

Mitchell, M. S., D. A. Ausband, C. A. Sime, E. E. Bangs, J. A. Gude, M. D. Jimenez, C. M. Mack, T. J. Meier, M. S. Nadeau, and D. W. Smith. 2008. In press. Estimation of self-sustaining packs for wolves in the Rocky Mountains. *Journal of Wildlife Management* (used with permission)

## **APPENDIX C: CONTACTS FOR IDAHO WOLF MANAGEMENT**

### **Idaho Fish and Game Regional Offices at:**

Headquarters Wildlife Bureau	(208) 334-2920
Panhandle Region	(208) 769-1414
Clearwater Region	(208) 799-5010
Southwest Region	(208) 465-8465
McCall Subregion	(208) 634-8137
Magic Valley Region	(208) 324-4350
Southeast Region	(208) 232-4703
Upper Snake Region	(208) 525-7290
Salmon Region	(208) 756-2271

For information about wolves in Idaho and IDFG management:

<http://fishandgame.idaho.gov/cms/wildlife/wolves/>

To contact IDFG via email:

<http://fishandgame.idaho.gov/inc/contact.cfm>

### **The Nez Perce Tribe's Idaho Wolf Recovery Program:**

Telephone: (208) 634-1061  
Fax: (208) 634-4097  
Mail: P.O. Box 1922  
McCall, ID 83638-1922  
Email: [cmack@nezperce.org](mailto:cmack@nezperce.org)  
[jholyan@nezperce.org](mailto:jholyan@nezperce.org)

For information about the Nez Perce Tribe's Wildlife Program and to view Recovery Program Progress Reports, please visit the following website:

[http://www.nezperce.org/programs/wildlife\\_program.htm](http://www.nezperce.org/programs/wildlife_program.htm)

### **U.S. Fish and Wildlife Service Northern Rocky Mountain Wolf Recovery:**

For information about wolf recovery in the Northern Rocky Mountains, please visit the USFWS website at the following:

<http://www.westerngraywolf.fws.gov/>

**To report wolf sightings within Idaho:**

Report online: <http://fishandgame.idaho.gov/wildlife/wolves/report.cfm>

**To report livestock depredations within Idaho:**

USDA/APHIS/Wildlife Services

State Office, Boise, ID (208) 378-5077

District Supervisor, Boise, ID (208) 378-5077

District Supervisor, Gooding, ID (208) 934-4554

District Supervisor, Pocatello, ID (208) 236-6921

Wolf Specialist, Arco, ID (208) 681-3127

**To report information regarding the illegal killing of a wolf or a dead wolf within Idaho:**

U.S. Fish and Wildlife Service Senior Agent, Boise, ID (208) 378-5333

Citizens Against Poaching (24hr) 1-800-632-5999  
or any IDFG Office